Missouri Botanical Garden

Research and Conservation: Maloids

Introduction— The Rosaceae (Rose Family) is one of the most important and conspicuous plant families, with more than 100 genera and 3,000 species. While the Poaceae (Grass Family) provides the most species essential for human food, grains, the Rosaceae includes treats like cherries, peaches, apricots, plums, almonds, strawberries, raspberries, blackberries, apples, and pears. Many ornamental plants also belong to the Rosaceae, including roses, cinquefoils, cotoneasters, crabapples, firethorn, flowering cherries, flowering quince, hawthorns, mountain ash, ninebark, shadbushes, and spireas. The Rosaceae are traditionally divided into four subfamilies: Spiraeoideae, Rosoideae, Amygdaloideae, and Maloideae. The subject of this poster is the Maloideae (Apple Subfamily), informally called "Maloids." [KR]

Diversity: Maloids— Most diverse and abundant in the temperate regions of North America, Europe, and Asia, Maloids consist of about 30 genera and 1,000 species and occur from the high elevations of Central America and South America to the subtropical regions of southern Asia and the Hawaiian Islands. Maloids are trees or shrubs, have a base chromosome number of 17, and have a distinctive, fleshy fruit called a "pome." Flesh outside the core comes from the hypanthium (floral cup) of the flower, while the flesh inside the core develops from the ovary wall. Pomes range in size from large apples and pears to small, ¼-inch crabapples. Many Maloids contain small amounts of the poison hydrogen cyanide in their seeds. However, one would have to consume large quantities of seeds for them to be dangerous. [KR]

Morphology: Leaves— Most Maloids are usually deciduous (except a few evergreens like *Eriobotrya* at bottom right), and have simple leaves with margins that can be entire (*Cotoneaster*) or variously toothed. In *Crataegus*, the leaves are often pinnately lobed, as in *C. molis* (left); a few species of *Malus*, such as *M. trilobata*, have palmately lobed leaves. Pinnately compound leaves occur only in *Sorbus* (bottom left) and *Osteomeles*. [KR]

Diversity: *Aronia*— The genus *Aronia*, chokeberries, sometimes included with *Photinia*, consists only of three species, all shrubs restricted to eastern North America. *Aronia arbutifolia*, red chokeberry, has small red pomes that persist on the plant through much of the winter, providing food for songbirds and other wildlife. *Aronia melanocarpa* has black fruits, while *A. prunifolia* has purple fruits. [KR]

Cultivation: Espalier— A method of training and pruning plants to grow more or less flat against a wall or other flat support, espalier is commonly applied to both apples and pears (right). The technique produces decorative branch patterns, and by careful pruning, showy flowers and a surprising amount of fruit in the fall. [KR]

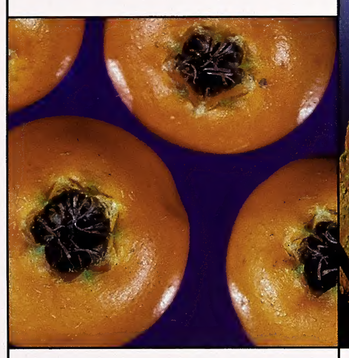
Origin of the Cultivated Apple— The cultivated apple, *Malus domestica*, is one of the most important fruit crops in temperate regions. It is uncertain when this apple originated, but the Roman statesman Pliny the Elder described 37 varieties in A.D. 77. Today there are over 2,500 varieties, although a mere handful produce the vast majority of the modern crop.

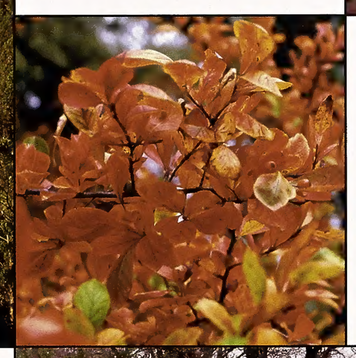
A possible progenitor of the cultivated apple is *Malus sierversii*, which occurs wild in the Tien Shan Mountains of Central Asia, especially in Kazakhstan and Kyrgyzstan. These apple trees are found frequently in mountain forests and along stream valleys, such as this habitat (right) in the Kurpsaj Ravine northwest of Dzhalal-Abad, Kyrgyzstan. [JT]

Diversity: *Pyracantha*— Shrubs of *Pyracantha coccinea*, firethorn, are covered in fall with small, brilliant orange pomes, relished by songbirds and thus widely dispersed. Consequently, it can be an invasive species. Rather than having a core, pomes of *Pyracantha* have 5 hard pits (stones, pyrenes). There are nine species of *Pyracantha*, all native to eastern Asia. [KR]

Conservation— Endemic to the island of Madeira off the western coast of Africa, plants in the threatened genus *Chamaemeles* grow along the island's steep basaltic rock faces. With shiny evergreen leaves resembling boxwood (*Buxus*), the plant is commonly known as "Box-of-the-Rocks." This image is of Cabo Girão, one of the highest sea cliffs in the world at 1,902 feet, 580 m. [KR]

Maloid Pollination— Maloids' flowers, like those of flowering quince, *Chaenomeles speciosa* 'Apple Blossom,' are rather unspecialized. The symmetrical open bowl lined with many stamens and a cluster of stigmas is visited by a variety of bees, flies, and beetles. Fragrance is variable, with two basic types: sweet (apples and quince) or unpleasant (pears and hawthorns). [KR]





Fall color— Some Maloids are known for their striking autumn color. *Photinia villosa*, Oriental photinia, has red-bronze foliage. This Chinese species is sometimes cultivated in the U.S. Some other cultivated Maloids with colorful leaves include *Amelanchier arborea*, downy serviceberry; *Crataegus phaenopyrum*, Washington hawthorn; *Aronia arbutifolia*, red chokeberry; and *Pyrus calleryana*, 'Bradford,' Bradford pear. [KR]

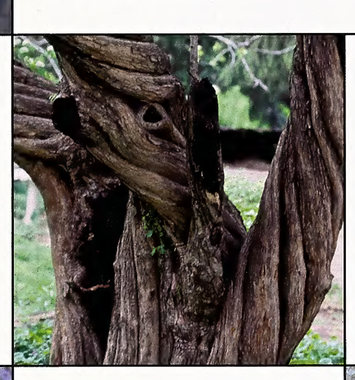
Diversity: *Pyrus*— The common edible pear, *Pyrus communis*, is not found in the wild but is a complex hybrid between different species native to central and eastern Europe and southwestern Asia. It has been in cultivation for at least 3,000 years, and many varieties have been developed. One feature of the genus *Pyrus* is the presence of "grit cells" in the flesh, although these are minimized in modern varieties.

There are about 70 species in the genus, all native to Europe and Asia. Some are cultivated as ornamental plants, foremost of which are the different cultivars of *P. calleryana*, 'Bradford,' 'Aristocrat,' 'Chanticleer,' and others. Some of these have become serious invaders of natural areas in eastern North America. [KR]

Diversity: *Cotoneaster*— A number of different species of *Cotoneaster* are cultivated, including *C. apiculatus* (below). Native to Europe and Asia, cotoneasters are small to large shrubs, or occasionally small trees. While more than 250 species are recognized, species delimitation is difficult because of extensive "apomixis," whereby locally adapted variants produce seed identical to the parents, since sexual reproduction is bypassed. [KR]

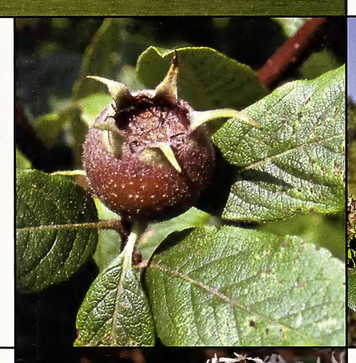
Ornamental Crabapples— Flowering crabapples fill the air with their sweet fragrance in spring. The cultivated crabapples comprise various species, hybrids, and cultivars. The most frequently encountered species are native to eastern Asia, *M. baccata*, *M. floribunda*, *M. sargentii*, and *M. sieboldii*. The four crabapples native to North America, *M. angustifolia*, *M. coronaria*, *M. ioensis*, and *M. fusca* are seldom cultivated. [KR]

Diversity: *Crataegus*— This gracefully twisted *Crataegus mollis*, downy hawthorn, now grows in a yard, but was once part of a farmer's fence row. *Crataegus* is one of the most taxonomically difficult genera in eastern North America. As in *Cotoneaster*, apomixis is widespread in *Crataegus*. The genus occurs natively throughout much of Europe, Asia, and North America southward into Central America. [KR]



Diversity: *Malus*— The genus *Malus* (apples) contains about 50 species in North America, Europe, and Asia, with the greatest diversity in eastern Asia, and includes five subgenera: *Malus* proper, *Sorbomalus*, *Chloromeles*, *Eriolobus* and *Docyniopsis*. Below, *Malus tschonoskii*, the pillar crabapple, is an unusual native of Japan of subgenus *Docyniopsis*. [KR]

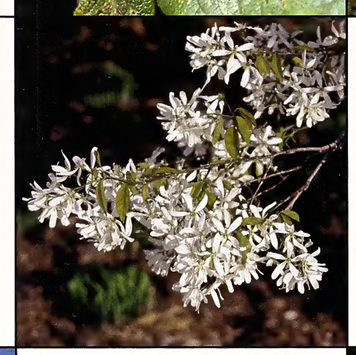
Fruit: *Mespilus*— Edgar Anderson, the father of economic botany at the Missouri Botanical Garden, wrote about *Mespilus germanica*, the medlar: "Even when ready to harvest in late autumn, medlars are not yet ripe enough to eat. After they are gathered they must be laid out in a cool place to be 'bletted,' a kind of controlled rotting." [KR]



South American Maloid: *Hesperomeles*— While Maloids are most abundant and diverse in the North Temperate Zone, examples can be found in other places. *Hesperomeles*, with about 11 species, occurs at higher elevations in the Andes Mountains from Bolivia to Ecuador and Venezuela, and northward to Costa Rica, where they are often encountered by MBG researchers in the field. [MBG]

Morphology: Flowers— This longitudinal section of a mature flower bud of quince, *Cydonia oblonga*, has 5 green sepals on the outside of the flower, and then 5 petals (pink and as yet unopened in this example). Inside the petals are the stamens, which vary from 5 to 60, depending on the genus and species; the anthers are usually yellow. [KR]

Ecology: *Sorbus*— The common name for the genus *Sorbus* is most appropriately "Mountain Ash," as exemplified by *S. scopulina*, Cascade Mountain Ash, growing on the slopes of Mt. Rainier in Washington. The genus *Sorbus* in the strict sense, plants with pinnately compound leaves, is comprised of about 100 species of the North Temperate Zone. Some taxonomists include species with simple leaves of Europe and Asia. [KR]



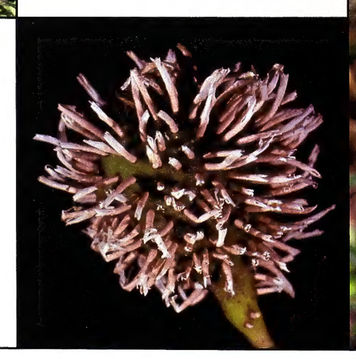
Diversity: *Amelanchier*— A variable genus in North America, with about 25 species, varieties, and hybrids with another two species in eastern Asia and one in Europe, *Amelanchier* are grown as ornamental plants because of their flowers, fruits, fall color, and smooth bark. They are called shadbush because they flower in early spring when the shad "run" or migrate into freshwater rivers to spawn in New England. [KR]

Fruits: *Amelanchier*— Immature fruits (below right) are pinkish and turn purple-black as they ripen. While technically pomes, the fruits resemble the unrelated blueberry. Limited commercial production of the fruits occurs in the northern Great Plains and Canada, where they are called Saskatoon Berries. Native Americans mixed dried *Amelanchier* and other fruits with fat, meat, and other berries to make pemmican, a main winter food. [KR]

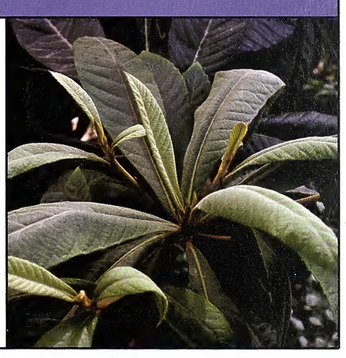
Recent Subfamily Classification— Molecular studies have confirmed that Maloideae are a single evolutionary unit (monophyletic). Most surprisingly, the genus *Gillenia* with two herbaceous species of eastern North America and a chromosome number of x = 9, was found to be related to Maloideae. *Gillenia stipulata* (right), Indian physic, occurs in open woodlands in most of Missouri. [KR]

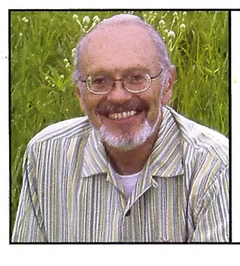
Fruit color: *Sorbus*— Most mountain ashes in North America have orange or red fruits. However, some species from eastern Asia have white, pink, crimson, and even pale yellow fruits. *Sorbus* 'Joseph Rock' (right) is named for Joseph Rock, who collected the seeds in China. Rock was a plant explorer in China from the 1920s to the 1940s. [KR]

Diseases as Taxonomic Indicators— Diseases can often be good taxonomic indicators, and Maloids are hosts to rusts of the genera *Phragmidium* and *Gymnosporangium*. These fruits of *Crataegus* (right) are infected with the Cedar-quince rust (*Gymnosporangium clavipes*). A bacterial disease, fireblight (*Erwinia amylovora*), is also confined to Maloids. [KR]



Warm-climate Maloid: *Eriobotrya*— This genus of evergreen trees or shrubs contains about 30 species, ranging from the Himalayas to Japan, southeast Asia, Sumatra, and Borneo. The most familiar species is *E. japonica* (right), loquat. Also cultivated, particularly as a small-sized street and yard tree, is *E. deflexa*, bronze loquat, aptly named for the bronze color of the new foliage. [KR]





About the Author: Ken Robertson is one of hundreds of botanists around the world who completed their Ph.D.s at the Missouri Botanical Garden. After spending six years at the Arnold Arboretum of Harvard University, he assumed his current position with the Illinois Natural History Survey, Champaign, in 1976. His research includes the classification and evolutionary relationships of the rose family, especially the apple subfamily (Rosaceae subfamily Maloideae), the pigweed family (Amaranthaceae), and the morning glory family (Convolvulaceae). Dr. Robertson also studies natural areas in Illinois, especially the tallgrass prairie. [MM]

Research at the Missouri Botanical Garden

With operations in over 35 countries around the globe, the Missouri Botanical Garden collaborates with local institutions wherever MBG botanists conduct research and field work, providing technical expertise, assistance with fund raising, and better communication with the worldwide scientific community.

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Studies concentrate on the plants of Meso- and South America, sub-Saharan Africa, Madagascar, China, Vietnam, and North America. Individual MBG scientists are specialists in the plants of particular regions, in the systematics and evaluation of major plant families, and in the interactions between plants and people.

The Garden serves as the headquarters for the Center for Plant Conservation and for several major collaborative publications, such as *Flora of China* and *Flora Mesoamericana*. Visit our website: www.mobot.org.

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1. Rainette Jaune d'Eté. 2. Rainette Rouge.

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